CLAIMS

1. A method for producing a dielectric insulating thin film, comprising:

a step (A) of making a substrate having a hydroxyl group in its surface or having a hydroxyl group introduced into its surface, adsorb a metal compound having a functional group capable of reacting with a hydroxyl group for condensation and capable of forming a hydroxyl group through hydrolysis,

a step (B) of removing the excessive metal compound from the substrate surface,

a step (C) of hydrolyzing the metal compound to thereby form a metal oxide layer having a hydroxyl group in the surface thereof, and

a step (D) of treating the above-mentioned layer according to any one treating method selected from the group consisting of oxygen plasma treatment, ozone oxidation treatment, firing treatment and rapid thermal annealing treatment to thereby obtain a dielectric insulating thin film.

2. The production method as claimed in claim 1, wherein the metal compound is a transition metal compound or a rare earth metal compound.

3. The production method as claimed in claim 1 or 2, which further comprises, between the step (C) and the step (D), a step (E) of making the metal oxide layer formed in the step (C) adsorb an organic compound capable of forming a functional group that may be adsorbed by a metal compound,

and a step (F) of removing the excessive organic compound from the surface of the metal oxide layer to thereby form an organic compound layer.

4. The production method as claimed in claim 1 or 2, which further comprises, between the step (C) and the step (D), a step (G) of making the hydroxyl group in the surface of the metal oxide layer formed in the step (C), adsorb a rare earth metal ion, and a step (H) of removing the excessive rare earth metal ion from the surface of the metal oxide layer and hydroxylating the adsorbed rare earth metal ion to thereby form a rare earth metal layer.

5. The production method as claimed in claim 3, wherein the steps (A) to (C) and/or the steps (E) and (F) are repeated at least once between the step (C) and the step (D) to thereby laminate at least two layers of metal oxide layer and/or organic-inorganic hybrid layer.

6. The production method as claimed in claim 4, wherein the steps (A) to (C) as well as the steps (G) and (H) are repeated at least once between the step (C) and the step (D) to thereby form at least two layers of metal oxide layer and/or rare earth metal layer.

7. The production method as claimed in claim 5 or 6, wherein at least two layers of metal oxide layer, organic-inorganic hybrid layer and/or rare earth metal layer formed contain different types of metal compounds, organic compounds and/or rare earth metals.

8. A dielectric insulating thin film obtained according to the production method of any of claims 1 to 7.

9. A dielectric insulating material comprising a

dielectric insulating thin film that has at least two metal oxide layers of different types of metal oxides, wherein the dielectric insulating thin film has a relative dielectric constant of from 1 to 40, and has a leakage current density of from 10^{-12} to 10^{-3} A cm^{-2} when an electric field of 1 MV cm^{-1} is applied thereto, and it has a thickness of from 10 to 50 nm.

10. The dielectric insulating material as claimed in claim 9, wherein the metal oxide is at least two selected from the group consisting of titanium oxide, tantalum oxide, zirconium oxide, lanthanum oxide, silicon oxide and hafnium oxide.

11. A dielectric insulating material having a dielectric insulating thin film that comprises at least one layer of transition metal oxide layer as well as rare earth metal layer and/or rare earth metal oxide layer, wherein the dielectric insulating thin film has a relative dielectric constant of from 1 to 100.

12. The dielectric insulating material as claimed in claim 11, wherein the dielectric insulating thin film has a leakage current density of from 10^{-12} to 10^{-3} A cm^{-2} when an electric field of 1 MV cm^{-1} is applied thereto.

13. The dielectric insulating material as claimed in claim 11 or 12, wherein the dielectric insulating thin film has a thickness of from 1 nm to 1 μm.

14. A dielectric insulating material having a dielectric insulating thin film that comprises at least one layer of metal oxide layer and organic compound layer.

15. The dielectric insulating material as claimed in

claim 14, wherein the organic compound contained in the organic compound layer is polydiallyldimethylammonium hydrochloride.

16. The dielectric insulating material as claimed in claim 14 or 15, wherein the metal compound contained in the metal oxide layer contains an Si element.

17. The dielectric insulating material of any one of claims 14 to 16, wherein the dielectric insulating thin film has a relative dielectric constant of from 1 to 100.

18. The dielectric insulating material of any one of claims 14 to 17, wherein the dielectric insulating thin film has a leakage current density of from 10^{-12} to 10^{-2} A cm^{-2} when an electric field of 1 MV cm^{-1} is applied thereto.

19. The dielectric insulating material of any one of claims 14 to 18, wherein the dielectric insulating thin film has a thickness of from 1 nm to 10 μm.